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A BOTANICAL TRIP TO ALASKA.*

By W. A. SETCHELL.

The summer vacation, so-called, is necessary for the teacher, not for rest in the sense of nothing to do, but as a means for activity in his own line or nearly related lines, which is impossible of attainment during the time when the greater portion of his energies is taken up by the work of actual instruction. To the student of natural history, the vacation period is of especial value, since it is the only time when he may be able to go into the field and verify, or search out the material for, those studies which otherwise only occupy him in the laboratory. If it were only for the purpose of obtaining fresh inspiration for lecture and other instructional purposes, it would be time well spent; but if the student is concerned with any problem of any size, to go forth into the region whence he may obtain the greatest amount of material and make the most valuable observations in furthering the investigation of the problem chosen, is absolutely necessary. In many cases, such localities lie at a considerable distance from the scene of academic work, and consequently there is need of a considerable outlay of money as well as the consumption of a considerable amount of time in making the necessary journeys. It has been the custom of the instructors and more advanced students in the Department of Botany of

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the University of California to employ all or a large portion of their vacation in collecting plants of various sorts, to increase the completeness and efficiency of the departmental collections as well as to furnish the subject matter for papers and theses. This has been true of the members of the Department since its inception as a distinct department under my predecessor, Professor E. L. Greene, and every summer has seen the departure of larger or smaller expeditions into various portions of the State or even to some extent to points beyond its boundaries. During the summer just past, the activity in collecting has been fully up to the average; and one trip, on account of the distance and the popular interest attached to the region visited, has attracted more than perhaps its proper share of attention.

Before proceeding to a description of this last trip, it may be well to mention briefly the other trips made during the summer, by members of the Department or by members of the University in connection with members of the Department. Mr. J. B. Davy spent between eight and nine weeks in investigating the flora of the cattle- and sheep-ranges of north-western California (in Mendocino, Humboldt, and Del Norte Counties), assisted by Mr. W. C. Blasdale of the Department of Chemistry. The work was both botanical and agricultural, and was undertaken in connection with the work of the Departments of Botany and Agriculture of the University and in coöperation with the Department of Agriculture at Washington. Mr. C. P. Nott devoted a considerable portion of the vacation to a study of the plants inhabiting the salt marshes about the Bay of San Francisco, together with the peculiarities of environmental conditions. Mr. H. T. A. Hus collected the marine algæ at Bolinas Bay in Marin County, and at S. E. Farallon Island. Mr. H. P. Chandler, a student and helper in the Department, collected about two hundred specimens in the Pajaro-Hill Region of Monterey County. Mr. H. M. Hall, a student and helper in the Department, made explorations among the

mountains of San Bernardino and Riverside Counties, a region of extreme botanical interest, from which Mr. Hall has already obtained many novelties. Mr. T. H. Gilbert, the janitor of the Botanical Building, brought back over two hundred very desirable specimens from his vacation trip into the Klamath-Plateau Region of Siskiyou County. Mr. Milo S. Baker, connected with the Department as a non-resident graduate student, collected plants in Modoc and Shasta Counties, paying especial attention to aquatic species. In addition to these collections made during the summer by members of the University, there was prepared under the direct influence of, and for the benefit of, the Department a fine and extensive collection of the seaweeds of Island County, Washington, by Mr. N. L. Gardner, now a graduate student in the University of Washington at Seattle.

The Alaskan trip was made by Assistant Professor W. L. Jepson, Mr. L. E. Hunt of the Department of Civil Engineering, Mr. A. A. Lawson, and myself. The trip was planned even before any announcement was made of the Harriman Expedition, and our party visited many of the places included in the itinerary of that expedition. The object of our trip was to study as completely and carefully as possible the plants of all groups growing on the island of Unalaska, and incidentally the plants of such other places in Alaska or along the Western Coast of North America as might become accessible on the journeys to and fro. The island of Unalaska was selected as being a subarctic locality, situated at a point intermediate between two important continental floras and at the lower limits of the upper division of the Northern or Boreal Zone of plant and animal life. Its geographical position also made it a favorable locality for the study of species of extended range from north to south or their substitutes of the same genera. Finally, the island of Unalaska is what botanists term the type-locality of a considerable number of North American species of more or less extensive range and concerning

which it is desirable to have more certain and ample knowledge. These and numerous minor reasons such as accessibility, facilities for work, comfort of living, etc., led us to decide to spend on this, one of the largest of the Aleutian chain, as much time as could be spared from our University work.

The expenses of the trip were defrayed from the private purses of the participants, and the trip itself could not have been undertaken, had it not been for the generosity of the various transportation companies who furnished transportation and other facilities free. Our thanks are especially due to the Alaska Commercial Company, the Pacific Steam Whaling Company, the Pacific Coast Steamship Company, and the United States Coast and Geodetic Survey for such privileges. We desire also to express our gratitude to Professor George Davidson, without whose assistance and advice the trip could never have been made.

We started from San Francisco on the afternoon of June 9, 1899, on the Steamer Bertha belonging to the Alaska Commercial Company. The trip across the Pacific Ocean to Unalaska was almost devoid of botanical interest but the floating animal life of the deep sea was both abundant and strange to us. Soon after we had passed the 100-fathom curve, we noticed that the surface of the ocean was thickly studded with small jelly-like animals of a pale bluish purple color and that these sometimes occurred very closely packed together in areas of several acres in extent. On examination they were found to have an internal paper-like skeleton, one portion of which was placed vertically to the main portion and obliquely to its median axis. This projecting plate-like portion, acted as a sort of sail. The sailors called them Portuguese Men o' War, but they are rather some species of Vellella. After a time, bunches of a light yellowish color began to be seen intermixed with the Vellellas and on examination, they were found to be Goose Barnacles. By watching their behavior in a bucket of sea-water, it was found that they ate the Vellellas,

stripping the gelatinous substance from the papery skeleton by means of their cirrhi; and this explained the existence of large areas of naked shells passed through. At times the ship sailed on through these empty shells for hours, it being impossible to detect any living animals at all. When we came within a day's journey of the Aleutian Islands, floating seaweeds of large size, almost altogether kelps and rockweeds, became more and more common, and their occurrence and species were carefully noted.

After a pleasant voyage of twelve days, we landed at the village of Ounalaska or Illiluik, on the evening of June 20. We set about finding quarters at once, and through the kindness of Mr. N. Gray, the Agent of the Alaska Commercial Company at that place, were soon comfortably installed in a very convenient furnished house and began our operations of observing, collecting, and preparing material at once. The party, with the exception of myself, remained at Unalaska for a little over eight weeks, making excursions mainly in the immediate neighborhood. The chance being presented of joining the steamer Patterson of the United States Coast and Geodetic Survey, through the kindness of Assistant J. F. Pratt in charge of the work of the vessel and of H. W. Rhodes, U. C., '94, Aide United States Coast and Geodetic Survey, through whom the invitation came, and of making a cruise in the upper part of Bèring Sea, I left Unalaska on July 15, and did not return until August 9. By this I was enabled to visit St. Michael and Cape Nome and extend our collections and knowledge of the flora of the upper division of the Boreal Zone, into the characteristic formations of a region essentially Arctic. On August 17 the whole party went on board the steamer Excelsior of the Pacific Steam Whaling Company, and about noon started out on the home journey, Sitka being the objective point of this portion of it. We found the officers very friendly indeed to our work, and Captain Downing especially willing to furnish us with all possible facilities for collecting at all points where a stop

of sufficient length was made. On this half of the trip home, we stopped at a number of places, at some of which we were able to make fairly complete collections. The places touched at were Belkofsky, Sand Point, Unga, Chignik, Karluk, Uyak Bay, St. Paul or Kodiak, Orca, Valdes, Yakutat, Juneau, and Sitka. We arrived at Sitka on September 3. We were delayed, on this trip of eighteen days, at several of these places long enough to enable us to collect the characteristic plants, and these were in sufficient number to make it possible for us to trace the extensions of plant ranges and the limits of the various subdivisions of the floras of the coast along the entire stretch between Unalaska and Sitka. From Sitka we proceeded on September 4 on the steamer Cottage City of the Pacific Coast Steamship Company through the "inland passage" to Seattle, which we reached on September 9. Although we stopped at several places between Sitka and Seattle, we had no chance to collect and could only observe the general features of plant distribution as we passed along near the land. We left Seattle on the morning of the 11th of September, and after a short and most pleasant voyage reached San Francisco on the morning of September 14.

The work laid out for us, then, was to make as complete a collection of the plants of that region of Unalaska accessible to us as possible, and to this we devoted our energies. Professor Jepson paid particular attention to the flowering plants, Mr. Lawson and myself to the flowerless plants, while Mr. Hunt helped each party by taking photographs of interesting plants and plant formations, determining altitudes in connection with zones of distribution, etc. We arrived at Unalaska when the vernal flora was at its height. We do not think that we missed anything by being late; and although we could not stay until the end of the season of flowering, we feel fairly certain that no very large number of species were left to blossom after we came away. The season, again, was especially favorable for our purpose, since it was a so-called

dry season, or one in which much less rain than usual fell. There was enough rain, however, to ensure an abundant crop of plants without being so much as to interfere seriously with the collecting and the drying of the specimens. Our collections, moreover, will be supplemented by a collection made by Dr. Albert Kellogg of San Francisco. He was a member of the United States Coast Survey party under Professor George Davidson, and the collection was made during the ascent of Makushin Volcano by a party under Professor Davidson's lead in September, 1867. A full set of numbers of this collection is in the Herbarium of the California Academy of Sciences, and will help us much, at least as far as the flowering plants are concerned, since it was made nearly a month later than any of our own collections and in a particular portion of the island which we were unable to explore. The island, too, is the place where a considerable number of the species of our North American flora were first found by the Russians, and whence they were originally described; and it is often of importance to obtain specimens of all these plants in order to be assured of the identity of what seem to be the same species, but which have been found elsewhere. Consequently careful search was made for all such species known to us and careful notes were made in connection with all species found, especially as to such characters as are not well shown by dried and pressed specimens. The altitudes at which certain species of limited distribution were found was determined in many cases since this is a matter not so pronounced in the subarctic regions as it is farther south. The Russian and Aleut names were sought for in all cases and noted down, as well as any uses to which various wild plants are put. One of the most interesting and at times the most striking feature of the plant life of Unalaska was the tendency of some one species to monopolize large areas to the partial exclusion of other forms. Even when other forms were present in abundance, a showy species would give such an appearance of monopoly,

that the other species might not be noticed except upon careful scrutiny. When one had risen on the hills a short distance above the sea-level, one found the ground to be carpeted with a heath-like covering of crowberry to a depth varying from a few inches to nearly a foot. This carpet gave to the hills a soft velvety brownish green appearance from a distance. When we first sailed into the Bay of Unalaska, on June 20, the hills were covered with cream colored anemones to such an extent that the mass of color was visible for a great distance. The anemone too ascended even to the very summits. Later this cream color from the anemone gave place to the lavender of the vast host of the northern geranium, while the lower marshes were soon purple with a magnificient iris or white with the abundant heads of the wool-grass. In the later summer, the hills became purple with the gigantic aconite, while the close of the season was heralded by the flaming masses of the omnipresent fireweed. All these are, of course, the conspicuous landscape effects that are constantly occurring in the regions where there is a considerable similarity of condition over more or less extensive tracts. There were many other and less effective plant communities occupying smaller space but no less interesting as to their associations both of plants and of exposure. Such were the forms associated with the very common plants of the parsley family, known as "Putzki," which was a favorite delicacy of the natives, filling with them much the same place that celery does with us. The fields of the large blue lupine formed at times considerable patches of color and varied in its tint more or less according to the altitude at which it was growing. A large purple violet occurred in abundance at first and was much sought by passengers from the various vessels. The most noticeable thing to us, however, was the absence of arboreous vegetation. Not a single tree of indigenous growth was to be found anywhere on the island. The largest shrubs, even, do not reach a height of over six or eight feet. A number of species

of willow existed on the island, but the majority of them did not raise themselves more than a few inches above the surface of the ground, even to blossom, their woody stems lying absolutely prostrate amid the mosses and other low plants, as if seeking protection. The Arctic alder seemed to be absent entirely, although present on the mainland both to the north and to the east. That tree-life is possible, is shown by the fact that there are at least two small groves of the white spruce in the neighborhood of Illiluik, which were planted by the Russians in the early years of the present century, and which now show well grown trees of fair height which produce cones with ripened seeds. No seedlings occur in the neighborhood of these trees, however, and it is evident that the conditions which prevent the growth of trees naturally on these islands are not such as are antagonistic to the adult tree but those which render successful germination, or at least successful seedling-growth, impossible.

Besides the peculiar and characteristic floras of mountain and meadow, of lake margin and barren rocky hill top, each of which had its own features of importance, the assemblage of flowering plants along the sandy or rocky shores of the sea, the strand-flora as it is called, had an interest wholly its own. For here it was, the only place in all Unalaska, where we found a circumpolar plant community. The species associated together on the margin of the sea were the same at Unalaska as at St. Michael and were the same at St. Michael as those reported for the coast of Labrador and Arctic Europe and the Asiatic side of the Bering Sea, and for the most part quite different from those of the coast to the south of these regions on either coast of either continent.

The Lower Plants were well represented at Unalaska and the collections made by Mr. Lawson and myself, show a very satisfactory array of the seaweeds, lichens, mosses, and ferns of the subarctic types. There were few species of ferns and related plants, although a great abundance of individuals of most of the species found

were present. The mosses were not represented by as great a variety of forms as were noticed farther east and the peat-mosses in the swamps occurred only in small and more or less isolated patches, which was entirely contrary to my expectation. The lichen-flora was, compared with other group-floras, comparatively rich and abundant, especially on the tops of the higher and more rocky hills. The algæ of the fresh waters were much more abundant than I had expected and yielded a number of forms very unfamiliar to me. The coast was a fairly favorable collecting place for the marine algæ or seaweeds, but the number of species was unexpectedly small, showing in this a decided Arctic characteristic. A number of the species, however, were of gigantic size as compared with their fellow species in the same genera elsewhere, and we were able to obtain measurements of certain of these far exceeding any recorded. The zones of growth were well marked in the tidal belt and just below, and were of entirely different sets of assemblages of species from anything found either to the east or south. Very few new species were found, but many interesting matters of distribution were noted in which, for example, plants hitherto unknown on the western shores of this continent were seen growing in great abundance. One most striking example of this may be mentioned in passing. A plant hitherto unknown except from the coast of Iceland was found in the greatest abundance on the shores of a small inlet just opposite the Alaska Commercial Company's wharf and nowhere else about the island. It has since been sent me, however, from the neighborhood of Puget Sound by Mr. Gardner. All such cases help us toward an accurate determination of the factors furthering the dissemination of such plants, a subject at present involved in much obscurity. The seaweeds while possessing many species in common with the various localities in Bering Sea, notably with Bering Island, St. Lawrence Island, St. Lawrence Bay, etc., with the Ochotsk Sea, and with the neighborhood of Sitka and that portion of the coast

to the eastward of Kadiak, partaking to a degree of the nature of each, do not agree with any of them in toto, but appear to be a sort of transition assemblage. The reasons for this may appear upon a careful study of the material collected.

The plants of St. Michael and Cape Nome were largely different from those of Unalaska, or had appeared in that locality only at the higher altitudes. At St. Michael, the tundra was developed in characteristic fashion, while no typical tundra was found anywhere about Unalaska. The dwarf birches, willows, and alders were abundant amid a growth of lichens, peat and other mosses; and low bog and heath plants made a soft, wet, yielding, spongy mass down to the place where the ground remained frozen solid, which as a rule occurred at a depth of from four to ten inches. On account of the proximity and enormous discharge of fresh water from the Yukon River, the seaweeds at St. Michael were those usually found in the brackish estuary of a large river.

The collections made by myself at St. Michael and Cape Nome, together with those made since my departure by Mr. P. M. Newhall, U. C., '98, of Captain Pratt's party on the Patterson, will enable us to work out a fairly complete flora of the shores of Norton Sound.

The trip to St. Michael and Cape Nome enabled us to obtain a fair knowledge of the changes to the north and these were found to be considerable, as I have just said. Now the trip to the eastward, returning, was of great service in revealing to us the great changes taking place in the complexion of the flora, both of sea and of land, to the east and south. For a time the country was treeless, covered with crowberry and resembling in all respects, as far as could be seen from the ship, the island of Unalaska. The miniature forests of alders and willows began to grow higher and higher, until at last on the island of Kadiak at Uyak Bay, on the north, willows, alders, poplars, and birches abounded which reached the height of

from fifteen to twenty feet. Still no coniferous trees were seen until finally on rounding the point of Kadiak Island at the northern end of North Strait, we saw scattered patches of white spruce. The patches soon grew numerous as we proceeded down the Strait, gathering themselves together into small groves, and after a few miles we sailed along in view of those matchless forests of spruce which are so characteristic of the lower portion of the Boreal Zone. From North Strait on, the coniferous forest was found down through the land of the totem until we came into the neighborhood of the island of Vancouver, when we exchanged the pure coniferous assemblage for one much mixed with deciduous trees; and the oak, the maple, the madrone, and other familiar trees of our own zone gave the landscape a very homelike appearance.

THE ADJUSTMENT TO CO-EDUCATION.*

By EDWARD B. CLAPP.

The University of California now has behind it an honorable history of respectable duration. Each year of that history has been marked by substantial progress, and the forward movement seems destined to go on with accelerated rapidity in the years which are next before us. He who would intelligently join in building the edifice of which we are already so proud, must therefore build upon the foundation which has already been laid. He must assume and understand the past, as he strives to develop out of it a still more perfect university fabric and life for the future.

The coëducation of the sexes is an integral part of the University's history. It is no longer an experiment, but a settled and, for the most part, a successful policy. Like the other leading features of our system, it is a part of the foundation upon which we are to build. It is not, therefore, the purpose of this paper to discuss the question of coëducation in its general aspects. That question has been thoroughly treated by competent investigators from almost every standpoint, both favorable and unfavorable, and the present writer does not propose to offer any addition to the arguments on either side. But it may not be amiss to state, at the outset, certain views which are the result of considerable thought and observation, and which form the basis for the remarks which will follow.

It is both expedient and right that women should have

*A paper read at a recent meeting of the Berkeley Club.

the same or equal opportunities for higher education as are afforded to men. In communities where it is possible for these opportunities to be offered to them in separate institutions, the question of coëducation becomes a purely theoretical one which may be left to philosophers to decide. But in new and sparsely-settled regions, where the resources of the community are taxed to the utmost to endow and equip one good university, it is right and expedient that that university be open to men and women alike, and under such circumstances coëducation should be loyally accepted. The well-known argument of Dr. Clark, in his work entitled "Sex in Education," to the effect that women are unfitted, by their physiological organization, to keep pace with men in prolonged and arduous courses of study, has been proved by experience to be groundless. So, too, the fear which has been so widely expressed, that young women would lose something of their maidenly delicacy in the daily contact with young men, and become coarse and self-assertive; or that both sexes, if educated together, would turn their thoughts to sentiment and romance rather than to study. Both of these fears have been completely dispelled by the actual outcome of the experiment. These two arguments have often been employed by the opponents of coëducation, but in the opinion of the present writer they have little weight. On the other hand, some of the grounds upon which coëducation has been most frequently advocated are perhaps equally uncertain. We have often heard that the new system would soften the manners of the ruder sex, through the refining influence of association with young women. But as a matter of fact the standard of manners in any institution is largely fixed by the average degree of cultivation in the homes from which the students are drawn. Well-bred young men will be gentlemen, even in a university where there are no young ladies, as the halls of Oxford and Cambridge can testify, while those of coarser nature and inferior breeding will remain much the same as before, even under the influence of coëducation.

The argument in favor of coëducation which has been most strenuously urged is found in the assertion that the presence of young people of both sexes in the same classes raises the tone of scholarship, each stimulating the other to greater exertions. But I doubt whether the experience of a quarter of a century has confirmed this. The scholarly standard of a university is set chiefly by the conscious determination of its officers, and there is no reason why this standard should not be as high in an institution for young women alone, or for young men alone, as in one which is attended by both sexes. If the faculty of a woman's college hold the opinion that education for young women must be somewhat diluted and weakened from the severest standard, then the result will be what we might expect. But if they begin with the determination to insist on the full rigor of requirement and attainment, they will have no difficulty in carrying out their ideal. The scholarly work done by the young women in Bryn Mawr College, in many of its departments, is substantially as advanced and thorough in its character as that in any institution in the United States, simply because its instructors are determined that it shall be so, and because they have the ability and scholarship to make it so. If it were true that excellence in the class-room played an important part in winning for either sex the admiration of the other, then indeed we might look for a marked improvement in scholarship as the result of coëducation; but, unfortunately, this is not the case, as all observers have frequently noticed.

I trust that no one will think that in expressing these opinions I am making a covert attack upon coëducation, for this is very far from my intention. I am simply trying to show that in this case, as in many others, the *a priori* arguments which have been advanced on either side have been proved by experience to be of little force, and that the question must be settled, as it has been settled, by practical considerations of convenience and economy. From this standpoint the position of coëducation in California is

unassailable, and no serious opposition to it is made in any quarter.

Let us admit, then, that there is no inherent difficulty in the education of both sexes together in the same institution, and that in many communities and under many conditions this is the best, or even the only, solution of the problem of the higher education. We proceed to the main topic which it is proposed to consider, namely, whether any further adjustment is necessary in our methods of organization, or in the whole plan of university life, in order to obtain the best results from the coëducational system. And if we discuss this question mainly from the standpoint of the interests and happiness of the young women in the University, it is only because they, as the latest comers in the university world, have perhaps suffered most from the lack of the slight adjustments which we shall suggest.

It should be remembered that the plans, the methods, and the traditions of university life have, to a large extent, been handed down to us unchanged from a time when the higher education was open to men alone. Coëducation, as practiced at present, consists in building an institution adapted as perfectly as possible to the needs of young men, and then saying to young women: "You may enter, and take anything you find suitable to your wants, but we shall make no effort to provide for your special needs." It might appear strange, at first thought, that such a course could ever have been adopted. But this has been brought about partly by the attitude of the strongest advocates of coëducation themselves. In their intense eagerness to prove the fitness of women for the most advanced studies, they have been unwilling to admit that this portion of the student body has any peculiar needs, lest herein should be found some confession of inferiority.

But this fear may now be dismissed once for all. No intelligent observer any longer pretends that young women are not capable of pursuing advanced studies at equal pace with their rivals of the other sex. The question which one

hears discussed most frequently is not whether the young women are inferior in scholarship to the young men, but whether they are not, on the average, superior. Yet the old fear still survives, and under its influence the position of our university women has been made to a certain extent an unnatural one; they have been pushed forward as the representatives of a cause, as the instruments in a *propaganda*, and their best interests have often been sacrificed through the mistaken zeal of those who have meant to be their best friends. If the whole question could once be taken out of the sphere of emotion and partizanship, and viewed with genial good humor and common sense, the way would be open to a great improvement over the present conditions. The only really vital end to be secured for women by coëducation is to afford them the best opportunities which the university can offer; to open to them the best courses and the best instructors, the full use of libraries, laboratories, museums, and all the other facilities which are provided for the men. But this has been freely done in all coëducational institutions. It only remains to raise the question whether besides all this it may not be possible to secure for our young women not only these advantages, but also those privileges and opportunities which have hitherto been found only in the woman's colleges; and for our young men, on the other hand, the same advantages which are enjoyed in the institutions for men alone.

It can hardly be denied, I think, that as a matter of fact, certain results are now more perfectly secured in the colleges for one sex than in those attended by both sexes. But I also believe that it can be shown that this state of things is not inevitable or necessary, but that all of the advantages of any system can be realized under coëducation, if wisely and sensibly administered. All that is necessary for this end is to recognize a truth which is undeniable, but which is often ignored, namely, that the needs of young men and young women in college, while the

same in many directions, are yet not identical at every point; and that when they diverge, the requirements of both must be considered and provided for, or else coëducation will always labor under great disadvantages.

For example, there are certain subjects in physiology, as there are certain authors in literature, which cannot be discussed freely before a mixed audience, until our ideas of propriety have undergone a change which it is hardly desirable that they should undergo. In coëducational institutions it has been the custom (with slight exceptions) either to ignore these subjects altogether, or else to treat them gingerly, in a superficial manner quite contrary to genuine scholarly thoroughness. It is easy to say, "Evil to him who evil thinks," and "To the pure all things are pure," but no one would dream of carrying out the idea involved in these maxims to its full and logical conclusion. In fact, the inevitable embarrassment which must arise from attempting to treat these subjects in mixed classes has often been made an argument against coëducation in general, but quite unfairly, as we shall see a little later.

Futhermore, there are many lines of applied science which bear upon domestic life, a thorough grounding in which would be of the utmost value to the future wives and mothers of the State, but which are almost entirely ignored in our courses of study. The interests of men are thoroughly considered, but those of women are neglected. We have whole buildings devoted to engineering and mining, but not a single full university course is offered in the chemistry of cooking or in domestic hygiene.

Both of these difficulties which we have briefly hinted at could be removed, and at very slight expense, if the university would once frankly admit that men are men and women are women. Why should not courses be offered for men alone, and for women alone, with the utmost freedom? And not mere courses of outside lectures, but solid university courses, to be treated seriously and given as high a scholarly character as any others. I think I am not wrong

in saying that the reason why this has not been done hitherto is the fear of seeming untrue to the principle of coëducation. It is felt by many that if we recognize for a moment that the educational needs of men and women are in some directions different, we shall thereby undermine the whole foundation upon which coëducation rests. But I hope that my readers will agree in the opinion that this fear is groundless, and that the one step in advance which we most need to take, in order to perfect our system, is to drop all such theoretical considerations out of sight, and view the whole subject in the light of practical wisdom and utility. As long as we regard coëducation as a sort of fetish, as an (almost) moral principle to which we must be faithful at any cost, so long shall we fail to secure the best results from it.

Much more might be said on this point. But enough has been said, I think, to show that it is quite possible so to shape our university work as to secure for our students, both men and women, not only those advantages which are inseparable from coëducation, but also those which have hitherto been gained only in institutions for one sex.

But we must pass on to another branch of the subject. It is in the direction of student organization, of the social life of the university, that our coëducational colleges have allowed themselves to be put to the greatest disadvantage in comparison with Wellesley, Smith, and Vassar, on the one hand; and with Harvard, Yale, and Princeton, on the other hand. If any one will listen to the conversation of a group of graduates of Wellesley, for example, and hear their reminiscences of college life, and observe the fondness with which their thoughts turn back to college days, it will be impossible for him to doubt that they have enjoyed a richness and fulness of experience which is denied to our young women here; that college life has meant more to them, has left a deeper mark upon them, than is the case in any coëducational university. They have not learned more, but they have enjoyed more. Short-sighted persons

may attempt to deny the value of this element in our academic life, and assert that the university need concern itself with nothing but the scholarly attainment of its students, and that all else is unimportant or even pernicious. But this feeling is based upon a narrow conception of what a university training is and ought to be. It is not enough that the university impart to its students a certain amount of systematic knowledge. It is not enough that it teach them to love the search for knowledge, and to know how to carry it on. University life ought to take hold of a man's whole nature, of his heart as well as his mind; and while it is storing his brain with facts and principles it ought also to store his memory with gracious ideals and inspiring recollections, to mould his whole future life by the influence of those happy years of delightful companionship with the choicest youth of his generation, engaged in the most ennobling of all pursuits. And this is no imaginative picturing of something which cannot be realized, but it is precisely what is accomplished for the young men of England, for example, by residence at Oxford or Cambridge. And though our admiration for these splendid institutions is somewhat lessened by the fact that as seminaries of scholarly investigation they have been surpassed by the universities of Germany, yet it is clear that the ideal American university of the future must not slavishly follow either model, but must combine the productive spirit of the German schools with the rich social life which is found at the English centers of scholarship.

If, then, it is admitted that the charm and interest of college life is an element of real value in education, and that in coëducational institutions, as at present conducted, that element is not developed so thoroughly as at Vassar or Smith, on the one hand, or at Oxford or Harvard, on the other hand, it remains for us to consider what adjustments are needed here also to make coëducation perfect. The answer is as easy to find in this case as it was in the other. We must simply recognize, here again as before, that men

are men, and that women are women; that the tastes and habits of the two sexes are, and will remain, different at many points, though at many others they are identical. To state the matter practically and precisely, and to apply the principle at once to our own situation here at home, let the seven hundred young women who attend the colleges at Berkeley develop for themselves a separate and independent college life, modeled after their own tastes and fashioned to their own ideals. Let the young men do the same. And let neither sex feel obliged, from a mistaken sense of loyalty to coëducation, to thwart and hamper their diverse aspirations by the hopeless effort to amalgamate what will not unite. The only result of such an effort is to produce a poor and feeble hybrid which is as unsatisfactory to the one side as to the other.

It is not necessary to make too much of the discontent which is felt by our students under present conditions. They are sturdy and loyal young men and women, and go about their work too busily to spend much time in repining. And yet it is impossible to close our eyes to the fact that some little dissatisfaction really exists. The young women sometimes complain of discourtesy from the other sex, while the men, too, are not without their grievances, real or fancied. It is of no use to say to the young men that they must act differently. They will not act differently. But I believe that all the difficulties arise simply from the effort to combine the various social activities of the two sexes, instead of letting them freely develop along their own appropriate lines. For example, a class ball is given. The young ladies perhaps complain that their masculine classmates invite outsiders to be their partners, and neglect their natural associates. Here the difficulty arises partly from an instinctive repugnance to constraint in such matters, and partly because of the greater maturity, in social affairs, of young women of any given age in comparison with young men of the same age. The sophomore young man finds the most congenial companionship in the freshman

girl, or perhaps in her still younger sister in a boarding school. But the remedy is easy to apply. Let the young ladies in any class conduct their own social affairs separately, and invite such young men as they find congenial. They would soon have the pleasure of perceiving that their invitations were sought for as eagerly as the invitations to a Smith College celebration (for example) are desired by the students of neighboring Amherst. A university election for football manager is held. The young men are irritated because their plans are upset by what they consider the irresponsible feminine vote. Here again the best advice to the young ladies would be to abstain from participation in the control of athletics, since that is a department of college life which belongs primarily to the men.

One of the happiest recollections of the Vassar graduate is the struggle for the class offices in senior year. The whole class is interested in the result, and the successful girl looks back upon her triumph, even in after years, with a thrill of pleasure. The same is true at most of the colleges for young men. But with us at Berkeley the uniting of the two sexes spoils the pleasure of the contest for both. The men cannot carry out their combinations on account of the perturbing votes of the young women, who are governed by motives which they cannot understand. The young women enter into the contest with no real zest, for the presidency is usually given to a man, after which, with almost contemptuous indifference, the vice-presidency is tossed to a woman. Or, on the other hand, women are sometimes in derision elected to all the offices, and the whole election made a burlesque. Here, too, the same remedy suggests itself. Let the young women in each class organize themselves as a class, precisely as they would do at Smith or Wellesley, and let the young men do the same. The whole difficulty disappears in a moment, since each portion of the class is at liberty to carry on its own affairs in the manner it enjoys best. No one defends the

unfortunate occurrence at a recent freshman meeting, where the young ladies were exposed to showers of ignominy at the hands of thoughtless sophomores. Such disorders can easily be checked. But will attendance upon a boisterous class-meeting of young men ever be a pleasant or edifying experience for refined young women? Can the ideals of the two sexes for the conduct of such a meeting ever be the same? And yet, at present, the young ladies must attend, or be charged with lack of "class-spirit," a most unfair situation to place them in, and one from which the change here suggested would relieve them at once.

It may seem to some that these illustrations are concerned with matters of little consequence. But they are only samples taken at random from some of the different lines of student activity, and the number could be multiplied indefinitely if space would permit. It is a fact that at almost every point where the activities of the two classes of students come into contact, outside the class-room, there is more or less chafing. Both sides suffer alike, though I think that the young women suffer most and would be most benefited by such a readjustment as I propose.

It will of course occur to many, as an objection to the view here advocated, that in the world at large the most agreeable and the most polished social intercourse is found where men and women meet on equal terms. But it is equally true that what gives to college life its unique charm is the fact that during those enchanted years the student is withdrawn, in a measure, from the world at large, and lives a peculiar life, narrow in many ways, but all the more intense and impressive on that account. It is often said that the student who lives at home while attending college loses much of the flavor of college life. But that very flavor which is valued so highly arises largely from the fact that it *is* a peculiar life, different from that at home and from that in the outside world. The life of the home and the world is the healthier and better life, as a permanent thing, yet no one who has ever enjoyed the experience and

impressions of the semi-cloistered days at college would be willing to forego them. But much of the atmosphere of that life can be secured under coëducation as successfully as in separate institutions, if young men and young women are left free to work out for themselves the forms of social life they enjoy best, and are not forced to unite in ways that are unsatisfactory to both. They are free now, so far as university regulations are concerned, but they feel themselves constrained by a sense of duty and loyalty to what is supposed to be the fundamental principle of coëducation. To show that this is an unnecessary and unwise extension of that principle is the object of this paper.

All that has been said may be summed up briefly as follows:

First:—The coëducation of the sexes in the same institution is unobjectionable in theory, and feasible in practice.

Second:—In its practical workings it has hitherto failed to produce in perfection certain desirable results which have been obtained under the other system.

Third:—These results may be obtained, without any sacrifice of the advantages of coëducation, by frankly recognizing, in the arrangement of studies, the occasional divergence of needs between the two sexes; and, in social matters, by allowing and encouraging each sex to develop for itself a separate and distinct college life, which shall give full play to those tastes and inclinations in which young men and young women differ.

If the views advanced in this paper are sound, the ideal organization for a great university open to both sexes would be somewhat as follows: In all scholarly exercises the young men and young women would, for the most part, meet together upon a perfectly equal footing, as they do now. The only change needed is that instructors should feel free to offer distinct courses for either sex, whenever it should seem desirable, without the smallest hesitation. But in everything else pertaining to student life, the two bodies would be organized separately and independently,

free to invite each other's presence at their meetings when they so desire, but equally free to enjoy themselves in their own way whenever they prefer to do so. The whole difference was summed up in a nutshell by the recent remark of a Wellesley senior to a visiting young lady from the University of Wisconsin. The latter was struck by the fact that Harvard students were very much in evidence as invited guests at the teas and festivities of Wellesley. At last she said: "You Wellesley girls talk against coëducation, but it seems to me that young men are about as numerous around here as they are at Madison." "Yes," said the fair Wellesleyan, "but it is one thing to have them when you want them, and quite another thing to have them all the time whether you want them or not."

HIGHER COMMERCIAL EDUCATION AND GRADUATE STUDIES.*

By CARL C. PLEHN.

Until within recent years little or no direct attention has been paid to anything but the rudiments of commercial education. The oldest College of Commerce in the world, properly so called, is but a few months over one year old, having been established at the University of California in August, 1898. The second, that of the University of Chicago, is one month younger. Columbia University claims the third, which it promises to inaugurate in October of next year, the plan for it having already been announced. Indirectly, however, under other names and in connection with other lines of study, much attention has been given to the subjects which necessarily constitute the higher course in commerce. Most of the larger universities have afforded opportunities like those afforded by our own College of Social Sciences for the study of subjects related to commercial life. Thus Harvard has for a long time offered its degree of A.B. to students who do well in a prescribed amount of these studies just as freely as to those who do well in Greek, Latin, and Mathematics. Perhaps the most conspicuous instance is that of the University of Pennsylvania, whose Wharton School of Finance and Economy, established in 1881, offers a course covering a

*Part of an address delivered before the California Union, October 17, 1899.

large part of the field. Nevertheless it was true that we seemed to have lost the ideal of higher commercial education and the thought that the merchant's profession should be made one of the learned professions came with something of the force of a new idea.

By a college of commerce we mean a course of study in the university having the same, or at least as high, entrance requirements as the other courses of study in the university; affording the same degree of mental training and of liberal culture as the other courses; and embracing only such subjects of study as are truly worthy of a place in a university curriculum; but differing from the other old courses or colleges in that it aims to make the calling of the merchant a learned profession in the same sense in which the older courses do that for the calling of the lawyer, the doctor, the minister, or the engineer. "For," to quote the words of Thomas Mun, "the Merchant is worthily called *The Steward of the Kingdom's Stock*, by way of Commerce with other Nations; a work of no less *Reputation* than *Trust*, which ought to be performed with great skill and conscience, so that the private gain may ever accompany the publique good."*

We may use the term business school to indicate those excellent technical schools, sometimes called business or commercial colleges, many of which both in this country and abroad have raised their standards of work to a very high level. There is a difference between these schools and a true college of commerce. This difference is as fundamental as the difference between the arts and the sciences. Training in the mercantile arts: in book-keeping, in accounting, in stenography, in the forms of business correspondence as carried on in different languages, in typewriting, and in office management, is one thing; and a study of the sciences related to industrial and commercial life is quite another thing.

In Europe the facilities for instruction in the arts of

*England's Treasure by Forraign Trade (1664). Chap. I.

business have been very highly developed,—far more so than in this country,—but there is nowhere in Europe a college of commerce in the true sense. The highest institution for commercial education in Europe is, perhaps, the Handelshochschule in Leipzig, which was established in April, 1898, and was heralded as the first of its kind in Germany. For seventy years the city of Leipzig has had a system of business schools of lower grade known as the Handelslehranstalt, constituting a part of its public school system. Instruction in these lower schools is given in large part in the day time, a feature in which this school differs from most of the business schools in Germany where instruction is given for the most part in the evening. The difference in the time of day at which the instruction is given marks a difference in the seriousness and completeness of the work. The Handelshochschule is a higher branch of the Handelslehranstalt. To show its character I abstract the following statement from a "Denkschrift" compiled by the Director, Professor H. Raydt. The purpose of the Handelshochschule in Leipzig is to give mature young people who have devoted themselves to a business career a two years' course in which they shall receive, together with a thorough mental training, a comprehensive mercantile and general education, and to give merchants' apprentices the necessary practical and theoretical professional training supplementary to their other education. The participants in the Handelshochschule are of two classes, pupils and hearers. Among the first are: (1) merchants, who have won the privilege of one year's voluntary service in the army (an educational requirement) and who have completed their apprenticeship; (2) graduates of the German nine-year higher schools (Gymnasien, Realgymnasien, Oberrealschulen); (3) graduates of German normal schools who have passed the teachers' examination; (4) foreigners over twenty years of age who have the requisite education. Among the hearers, admitted only to certain lectures and exercises, are students

of the University of Leipzig, merchants in business, teachers, civil officers, etc. There is no entrance examination.

The school is connected with the University of Leipzig to the extent that certain of the university lectures are included in its curriculum or are open to its students. The curriculum consists of two parts: (A) Lectures on (1) Political Economy, (2) Public Finance, (3) Technology, (4) Geography, (5) Economic History, (6) Jurisprudence, (7) Commercial, Banking, and Admiralty Law, (8) Bankruptcy Law, (9) Industrial Legislation, Insurance, Insurance Law, (10) Constitutional Law, (11) Colonial Politics, (12) Pedagogical Lectures for teachers in Commercial Schools, (13) Lectures on Culture; (B) Exercises in (1) Mercantile and Political Arithmetic, (2) Bookkeeping, Commercial Correspondence in German, and General Accounting, (3) Chemistry, (4) French, (5) English, (6) Italian, (7) Spanish, (8) Russian, (9) Stenography, (10) Occasional Exercises on the Typewriter.

While it must be admitted that the standard of this school is high and that it is conceived in a broad spirit, yet a two years' course largely in the arts does not fulfill the requirements of a college of commerce.

A glance at the business schools of other European countries is not without interest. In Austria there has been for a number of years a Commercial Academy located at Vienna which is supported by a private association with the endorsement and approval of the government. In 1898 there was established in the same city an "Export Academy", the plan of which is not altogether unlike that of the Leipzig school although the standard is not so high. Ever since 1884 Italy has had a "Royal Higher School for Industrial and Commercial Studies" located at Genoa. The course is three years, the first of which deals with the arts of the counting room, the second with economic science, and the third with languages. This school rests on an excellent system of preparatory technical or commercial schools. In England less perhaps has been done than in

other countries. In conformity with the well-known ideas governing the English educational system, commercial education is encouraged by requiring applicants for positions in business houses connected with the different boards of trade or chambers of commerce to pass an examination set by the board. But no public provision is made for the preparation of these applicants. In London there is an excellent School of Economics which undertakes to prepare young men for these examinations. In Belgium, at Antwerp, there is the famous "Institute of Commerce" with an excellent two years' course and stiff entrance requirements, which include a knowledge of French and German. This Institute is partly supported by the government, and grants to its best graduates traveling fellowships of over $1,000 per annum to enable them to visit and study in foreign countries.

But I suppose it is generally admitted that in the matter of commercial education the highest place next to Germany is held by France. The highest commercial schools in France may be exemplified by the "Ecole des Hautes Etudes Commerciales" in Paris. The course is two years and the applicant for admission must be at least sixteen years of age. The entrance requirements are Composition, Mathematics, French Literature, Physics, Chemistry, History, and Geography, and either English, German, or Spanish. The pupils are prepared for business, for the consular service, or for the civil service and for positions in the teaching force of the lower commercial schools. Graduates are entitled to public positions in that branch of the service for which they are prepared.

From all that can be learned concerning these schools in Europe it appears that they should be classed as business schools rather than as colleges of commerce. They are excellent in plan and in execution. They are the models toward which our business schools must work. But they afford little help or suggestion as to the arrangement of the curriculum of a true college of commerce. The aim of

university education is not to manufacture machines but to develope men. The college of commerce aims to give the business man a broad outlook, to teach the methods of clear thinking, to expound the fundamental principles or truths concerning the conditions under which the business of the world is done, to enable the merchant to understand the world forces, to contend against which is folly, and which to guide and direct requires the highest mental ability. But it will not, cannot, and must not attempt to give all the necessary facility in the arts of business. It will never do away with the necessity for apprenticeship in some particular branch of trade. It may teach a railroad man something about the principles by which freight rates are determined, but it will not teach him how to bill a car-load of goods from Suisun to Rochester.

"Commercial education will never reach its highest grade of efficiency in an institution devoted only to commercial education. The separation of commercial education from higher work in the economic and commercial sciences produces a dangerous divorce of the scientific men on whom you must depend for your books, for your investigations, for your generalizations on industrial and commercial movements, from the practical men of business. The commercial institution should be of university rank, and of a university type of organization. It should in fact be the economic and commercial faculty of a great university. The economic and commercial sciences should be pursued to the highest pitch of perfection within the walls of the institution where the commercial training is given. There, not only should men be trained for the business of life, but men should be encouraged to extend the limits of our knowledge. It is only in this way that the best results can be achieved, and higher commercial education be made to rank with the scientific training which is revolutionizing the world."*

*From an address by Professor Hewins, Director of the London School of Economics.

The necessity for higher training of this sort arises as I have shown elsewhere* from the great expansion of commercial and industrial enterprises in the last ten years; and that very expansion affords the greatest possible opportunities for graduate work in this line. In the opinion of many well-informed persons the traditional learned professions are becoming somewhat over-crowded. But whether or no this opinion be well founded, whether or no there are too many teachers, lawyers, ministers, and doctors, there certainly can never be too many highly trained business men. Every one of these men will produce some material thing the world needs or will help the people of the world directly to obtain something which they need. We could possibly cut off half our litigation, close half our courts, and discharge half our lawyers with a considerable increase in our happiness. But if our industries could double their output and our merchants could exchange the increased output for twice as many of the products of other nations as we now have, we should still have thousands of unsatisfied wants and it is not possible to conceive that the human heart should ever cease to long for new gratifications that can be satisfied only by our industries and our commerce.

Therefore the course in commerce opens up a field for graduate study more comprehensive, perhaps, than that of any other undergradurte course. There are few fortunate individuals in the world who are blest with inherited wealth so great that they can pursue a scholarly life simply for the love of knowledge. And it is rare that any graduate student takes up his work without the hope of applying his knowledge in some definite field. If the field of study open to graduates in the traditional courses is possibly somewhat overcrowded that opened by the course in commerce is to a large extent virgin soil and is of such limitless expanse that overcrowding is practically unthinkable. Furthermore this field is in every one of its

*Merchants' Association Review, October, 1898.

departments intensely, fascinatingly interesting. After all the most interesting thing in the world is man, and the most interesting thing about man is the way he earns his living.

By way of illustrating the size of the field and the opportunities for graduate work therein, let us take one or two of the subjects to which a graduate student might turn his attention with profit to himself and, what is the same thing, advantage to the community. Take, for example, statistics in all its thousands of applications, a science in which very, very little serious work has as yet been done. I imagine that very few people are aware that there are not enough expert professional statisticians in any country properly to equip a complete census bureau. Although many of our states have so-called bureaus of labor statistics, yet with one or two exceptions the true statistical work of these bureaus has been abandoned and other work, like that of a public employment agency, taken up largely because of the dearth of trained men to do the work. In Europe many of the Chambers of Commerce employ expert secretaries, whose work is mainly statistical and whose services are of enormous value to their cities. Scarcely anything of this kind is done in this country, not because our Chambers of Commerce are not alive to the necessity of it, but because there are no men trained for the work. Take for sake .of illustration again, the opportunities afforded by some of the different branches of our federal government. There is the State department, which will undoubtedly use thousands of trained graduates of courses in commerce, and whose service in turn affords the most ample opportunities for advanced work. There is the Treasury department with a demand for many more, the Post Office, the Interior, including for the larger part of every decade, and let us hope permanently in the future, the census office; and there are all the different commissions, permanent and temporary, such as the Interstate Commerce Commission, the Commission of Labor, the Intercontinental Railway

Commission, the Interoceanic Canal Commission, the Industrial Commission, etc., etc., all of which require from time to time a great number of men trained in these very lines.

It may be objected that many of these places are given as the reward for partisan political services and the tenure of office is too uncertain to warrant a young man in devoting three or four years to graduate study in preparation for such work. To a large extent this has been true. But I am convinced that the chief reason for it at the present time is that there is a dearth of men with the proper training. I know that in many cases the best trained men available have been appointed, and I know that the tendency to call upon properly trained men is growing stronger every day. A survey of the different departments of the government at Washington reveals the fact that a very large number of positions requiring technical training are filled by men whose qualifications are unquestionable.

The chosen representatives of the people must in the nature of things be relied upon to make recommendations for appointment in the government service. There is no other way of finding the men needed. Our Representatives are not inclined at the present time to recommend unqualified persons and are usually glad to be able to recommend the best equipped persons they can find. I am sure that no young man who could say, "I have knowledge of the Chinese language, know the rules of international law, the geography and products of the Orient, am a competent statistician, and have a grasp of the principles of economic science; and I desire an appointment as assistant in some consular office in China" would fail of the necessary endorsement.

But aside from the public service, which may in time become overcrowded with trained men, there are innumerable opportunities in the business world. Organization on a large scale is to be the rule in the future; combinations, trusts as we are prone to call them, will control every industry which obeys the law of increasing returns. If it

is cheaper to mine and distribute oil on a large scale than it is to do it on a small scale, it will be done on a large scale; and we can only prevent it by destroying the institution of private property entirely. But the organization of industry on a large scale requires men of larger calibre than those who sufficed for the older plan. Some of these men the industries themselves have trained, but a large part of the friction which these combinations encounter is due to the smallness and narrowness of the men who presume to guide them. In the words of Thomas Mun, quoted above, these men have a work of "no less *Reputation* than *Trust*, which ought to be performed with great skill and conscience, that so the private gain may ever accompany the publique good." A gas company guided by men who understand only the principles governing the older competitive system, charges exorbitant rates, limits in that way the number of its patrons, comes into conflict with the law and the public authorities, constantly tempts competitors into existence whom it has to buy up, increases its capitalization in this and other ways until it is no longer possible to earn reasonable dividends by reasonable rates, and ends in ruin and disaster. Another, under enlightened management, expands its business by reasonable rates, is never in the courts, never has to fight hostile legislation, never tempts would-be-competitors to blackmail it by the construction of unnecessary plants, blesses the community which it serves, and pursues a career of ever-widening prosperity. The difference arises from the observance of some of the simplest principles of economic science, which can be just as easily learned in college as in the bitter school of experience.

I have touched but on the edge of the limitless field from which the graduate student in commerce can choose. Possibly, however, enough has been said to show that there is room here for the loftiest ambitions.

THE PHILADELPHIA COMMERCIAL MUSEUM.*

By GEORGE DAVIDSON.

Last June, at the request of the management and President of the Philadelphia Commercial Museum, I was accredited a delegate and representative to the formal opening of the Congress by the Chamber of Commerce of San Francisco, and subsequently by the University of California, the Geographical Society of the Pacific, and the Mechanics' Institute. My attendance was made possible by your recommendation to the Board of Regents of the University for the necessary leave of absence, and I was present in Philadelphia on the tenth of October, the first day of the Congress of Foreign and Home Delegates.

My special object of inquiry was the collection of products and a study of the methods and administration of the Philadelphia Commercial Museum, which body, in concert with the Franklin Institute of Philadelphia, developed the separate organization of the National Export Exposition.

Before giving any details I should state that, although familiar with the objects and general operations of the museum by correspondence, and by the published pamphlets of the organization, I was astonished at the remarkable exhibit of the collection of more than 200,000 samples of the raw products, materials, and partly manufactured

*Extracts from the report to the President of the representative of the University of California at the Congress of the National Export Exposition, held at Philadelphia, September 14 to November 30, 1899.

productions of nearly all the countries of the earth. Every specimen is classified, labeled, and open to inspection and study. General tables are presented giving the amount of production and values in the different countries to the latest date.

I officially examined the great expositions of Paris in 1878 and in 1889, but I have seen no such special exhibit as this of the Commercial Museum. Foreign delegates who are familiar with the commercial exhibits and museums of other countries have not found its equal in breadth and thoroughness. The Swedish delegate reported that he had been especially commissioned to examine the character and methods of this institution. For some years past he has been visiting and studying foreign and commercial museums in order to devise one for his own country. He declared this museum to be in advance of all that he has seen, and a model to be adopted.

As one searches through room after room and hall after hall of the great building, the comprehensiveness and thoroughness of the scheme unfold and impress one more and more as the details are revealed and the wealth of information realized. The method of presenting these tangible products and the various means of utilizing the daily accretions of material and information brought to the institution show the large and broad purpose of the governing board of directors. To this is added the remarkable administrative and executive ability of the Director and his corps of expert assistants.

In my judgment no commercial centre should be without such an organization and exhibition. The producer, the manufacturer, the merchant, and the student would thereby have placed before them general and specific information of authoritative character such as can hardly be gathered in any other manner. The manufacturer in any particular line will there find the raw products from every country and clime, and the bureau of information will give him positive information about the amounts and seasons of

production, the cost, the methods and rates of transportation, and the names and standing of the principal producers or dealers, obtained through hundreds of traveling experts, representatives, and foreign correspondents.

I have been so impressed with the value of such a Commercial Museum to this Pacific Coast that I trust the University of California will, in every legitimate way, promote and foster the organization of a similar institution in San Francisco. It would be one of the broadest means of giving aid and information of inestimable value to every student and to every industry and profession on this Coast. At this particular period many influences conspire to make its realization possible. * * * *

THE INCEPTION AND ORGANIZATION OF THE MUSEUM.

The Philadelphia Commercial Museum had its origin in the successful movement of a few large-minded and far-seeing citizens to secure the vast exhibits of natural products brought from the many countries represented at the World's Columbian Exposition at Chicago, in 1893.

These collections were presented to the municipality of Philadelphia, and the good faith of that city was pledged to their proper care.

This good faith has been shown by repeated appropriations of large sums of money to insure their proper installation and to promote the development of the work of the institution.

From the outset it was recognized that this work which had thus originated in international coöperation should be of a national and international character. And in order that this large idea should be carried out the City Councils of Philadelphia organized the Philadelphia Commercial Museum, June 15, 1894; and at the same time a board of trustees was created. This board was composed of twenty members, comprising the highest officials of the State and of the city, and distinguished citizens. Immediately thereafter an advisory board was established, composed of official

delegates from the leading commercial bodies of the United States of America and of our sister republics. Without a single exception the invitation to leading commercial bodies in all parts of this continent was accepted. In this board there are now two hundred and fifty foreign and one hundred and fifty domestic organizations represented: the several foreign ministers and ambassadors at Washington are members.

This advisory board holds an annual meeting in the city of Philadelphia, at the museum building, in the month of June. It exercises a general supervision over the administration of the museum in order to promote its development, and to foster the efficiency of its service for the interests of commerce. It elects its own officers.

THE MAINTENANCE OF THE MUSEUM.

This institution has now in its service one hundred and seventy-five persons, but it is not dependent in any sense on profit-making for its maintenance. It has a reasonable membership for which the charge is now $100 per annum; and for special reports only the actual cost of compilation is charged. The City of Philadelphia has been generous in the gift of ground for the erection of permanent buildings, and in meeting the current expenses of the museum. From time to time the State of Pennsylvania and the National Government have extended financial aid. In five years, ending August, 1899, the Government,* the State, and the city have given a total of $1,065,000 for the maintenance of the organization, the collection of samples, and the erection of buildings. Up to this date the city has deeded to the museum ninety acres of land on which the permanent buildings are to be erected.

At the inception of this institution the management of the Pennsylvania Railroad Company, believing the museum was destined to be an important factor in the development

*Last session Congress appropriated $350,000.00 for the Exposition buildings, etc.

of the foreign trade of the country, leased their former general offices to the museum for five years at an annual rental of one dollar. This building contains more than one hundred rooms, with a floor space of over 200,000 square feet.

The new buildings of the museum, now under construction in a central part of the city, comprise three large four-story edifices with connecting buildings. The institution is entirely free from indebtedness.

THE SPECIFIC WORK OF THE MUSEUM.

The museum was designed in the first place as an institution for the advancement of international trade, and its development has followed the broad lines which experience has shown to lead most directly to the end desired.

A merchant or a manufacturer who wishes to trade in a foreign market must first know in specific terms the character and value of that market. Granted that its trade will repay the effort of securing it, he must know exactly what the market requires, what it can offer in return, what are the business houses to deal with, and what are the conditions on which business is customarily carried on.

The museum contains collections which supply these various requirements. In the present building they are classified under the following heads:

(1) *Raw Products:*

(*a*) Geographic arrangement of collections. (This is the arrangement that the student prefers.)

(*b*) Monographic arrangement of collections. (This is the arrangement that the manufacturer and the trader more particularly desire.)

(2) *Manufactured Articles:*

These are arranged in lines of manufacture.

Raw products geographically arranged.—In this arrangement the raw products collections show at a glance what is produced in any given country, and what that country

has to offer by way of return trade. If, for example, a merchant or manufacturer wishes to inform himself upon the Mexican trade, he will find in the Mexican department of the museum samples of the hennequin or sisal hemp, the maguey, ramie, and other commercial fibres; the hides, wools, cottons, gums, resins, ores, tobaccos, coffees, woods, drugs, etc., of Mexico, and their locations.

Monographic collections.—If the merchant is interested in one particular line of raw products, such as tanbarks, dye-stuffs, oils, kaolins, seeds, etc., he will find collections of each class, in which the products of all the world are brought together for comparison.

Technical laboratory.—The collections of raw products are made practically useful by the scientific and technical laboratories of the museum, where complete tests are made with special reference to the industrial value of any given product. The usefulness of this method is well established in many countries, and merchants are continually sending samples of exportable products in order that the museum may report upon their suitableness for the American market.

Collections of manufactured articles.—Having shown the producing capacity of any given country, the museum shows also the consuming capacity by collections of the goods that are the most salable. These are actual samples of what is in the markets, selected with great care by the expert agents of the museum. Textiles, hardware, clothing, household goods, cutlery, provisions, etc.,—everything that is imported—are represented in these sample collections. With each sample is found attached full information as to place of manufacture, the market (special or general), price, terms of sale, distribution, etc.

THE BUREAU OF INFORMATION.

One of the most important departments of the museum is the bureau of information which gathers, classifies, tabulates, and circulates the trade and commercial knowledge

of most of the countries up to date. This is the feature of greatest interest to the American manufacturer, merchant, producer, and ship owner.

The foreign connections of the bureau are very extensive and are among the best in the world. It maintains independent relations with nearly two thousand foreign banks in trade centres, with many reporting agencies, with the United States Consular Service (under special instructions from the National Government), and with a very large number of special correspondents; and, in addition, it possesses the privilege of the sole American rights to the confidential reports of the associated foreign banks of England. These sources of information, many of which are exclusive, are supplemented by trade journals, commercial and shipping gazettes from all ports, government and local reports from all countries, and by directories, so that the bureau becomes, in fact, the most extensive and best-organized foreign commercial agency in the United States, and greatly superior to any similar organization in the world.

The bureau, through its representatives, is kept fully advised as to the names and standing of business houses, merchants, and buyers the world over; trade opportunities, requirements of the markets, goods sold by manufacturers in other countries, with prices, terms of sale, banking and exchange, freight rates, tariffs, packing, means of transportation, and all other matters of commercial interest.

For members who wish to receive the full advantage of this work and to follow it up by a systematic effort to secure foreign trade, there has been arranged a regular service which includes:

Frequent reports on trade conditions in foreign markets, with the prospects for the sale of the particular line of goods or manufactures in which the members are interested; showing the character of the goods in use in any country, the country from which imported, the names of foreign manufacturers, the price at the factory, the quantity

imported annually, the transportation charges from the country of origin compared with similar charges from the United States, the duties, the manner of packing, and the names of possible buyers; the financial standing of foreign business houses; answers to any inquiries that will help members to introduce their goods into foreign markets; special communications to acquaint members with trade opportunities meriting prompt attention. Through its intimate relations with foreign governments, trade organizations, and business houses, the bureau is able to keep close watch upon new enterprises abroad, and to notify members of calls for bids on work of public or private construction, and of chances for the introduction of American goods; suggestions as to the most desirable points for the location of foreign agencies, and concerning houses and individuals who may be best fitted to act as agents, and methods by which any line of trade may be most successfully introduced and maintained. This important work is done by special conference or correspondence with each member in the strictest confidence.

As a means of easy reference the bureau keeps up a Card Index Cabinet which contains a selected and classified list of prominent importers and merchants handling the goods sold by members. Each name is on a separate card, and the card contains sufficient information to show the importance of the firm, with its history and standing (verified by the houses themselves and the museum's correspondents). The cards are arranged by countries and subdivided by cities; they may be used to supply various special lists of buyers in any market, and by their use as complete and systematic work can be done in any foreign field as is possible in the United States.

In order to place the names of American business houses where they will reach the eyes of the important and reliable buyers in foreign countries, the museum uses card index files containing specially printed cards giving the names of the houses and descriptions of their goods. These cabinets

have been placed in charge of chambers of commerce, boards of trade, and United States consulates in forty-four cities of twenty-four countries.

The charge to members for the various services is based upon the estimated cost of compiling, copying, and mailing reports. These fees are not intended for the maintenance of the museum.

The services of the museum are always at the disposal of foreign merchants, producers, and customers for obtaining information concerning American goods and firms, or the establishment of commercial connections. Services of this character are conducted confidentially, impartially, and without charge.

The character and scope of the commercial reports furnished by the museum are exemplified by the summary of one week's work taken at random from the files of the institution:

REPORT OF THE COMPILING DEPARTMENT.

Number of inquiries answered:

Domestic	109	
Foreign	29	
		138

The foreign inquiries were from twenty-three countries in Europe, Asia, North America, South America, and Australia.

The number of regular reports to members	415
The number of subjects covered by these reports	83

The extent of the bureau itself is further shown by the number of departments into which it is divided, and the number of persons employed in each: the Foreign Department, with thirty-five employees in the central office and 65,000 foreign agents and correspondents; the Compiling Department, with twenty-five employees who are experts in their various lines of trade. They collate and distribute the reports received from abroad, issue the special reports to members, handle a daily service of immediate news items of value to American manufacturers and exporters, and supply a press syndicate with general descriptive

information; the Library and Translating Department, for securing the world's supply of commercial data in print and for the translation of members' foreign correspondence; the Filing and Mailing Department, which employs ten experts who handle a correspondence as high as 100,000 communications monthly; the Printing Department, which employs fifteen persons and uses three electric presses, binding, cutting, stapling, and other machines. It has a monthly record of 850,000 impressions; the Stenographic and Typewriting Department, with upwards of thirty experts; the Foreign Trades Directories, which is a special section that comprises the directories for the large cities and country districts of over forty countries, the whole commercial world being covered. These directories are open to inspection by members, but for reports the bureau does not depend upon these directories but on its foreign lists verified by its own agents, correspondents, and the firms themselves. In rare instances where the character of the report calls for a general trade list, these are uniformly taken from local directories published in the country in question; and are never gathered from gazeteers, commercial annuals, or similar publications of a general nature.

The museum contains 200,000 samples of articles of foreign commerce with which similar American lines must compete in the open market. The exhibits of natural products of other countries of possible value in American industries reach about 250,000. The space occupied, ground measurement, is 200,000 square feet, but it should be much larger and better lighted.

The library receives 1,420 foreign and domestic trade and technical periodicals; and under the head of commercial publications has upon its shelves 1,260 books and 17,250 pamphlets in eighteen languages.

The number of foreign correspondents, representatives, and traveling agents sending regular reports and information is 378; foreign correspondents sending frequent data,

700; foreign trade organizations connected with the museum, 250; domestic ditto, 150; banks and bankers in correspondence with the bureau, 1,604; American consuls with whom regular correspondence is maintained, 364; consuls of foreign countries, 300.

Foreign firms, verified and classified for subscribers' use, 25,000. The number of separate lines of trade now covered by specific data, constantly renewed and extended, is 480.

This resumé gives in very brief outline the greatness of the work which the Philadelphia Commercial Museum is doing for the commerce and industries of the United States; but the museum management has brought the exhibits and the commercial and technical data to such a state of completeness that, without inspection and study, the extent and value of its collections and information cannot be thoroughly comprehended.

MEMORANDUM ON A PROPOSED COMMERCIAL MUSEUM AND BUREAU OF COMMERCIAL INFORMATION.*

The anticipated expansion of trade on the Pacific Ocean suggests the advantages of the establishment in San Francisco of a Commercial Museum similar in scope and purpose to the Philadelphia Commercial Museum and affiliated therewith. The establishment of such a museum was part of the original plan of the College of Commerce. For obvious reasons the connection of such a museum and bureau with the State University is peculiarly appropriate. The following outline of a tentative plan is submitted for consideration:

Objects:—(1) To collect and exhibit all those raw products of foreign countries which might be useful in American manufactures. The raw products collected should be properly analyzed and examined, and reports on their properties for manufacturing purposes prepared.

* Submitted to the President of the University by Carl C. Plehn.

(2) To collect for the use of American manufacturers and merchants accurate and complete information concerning the state of the market for all American products in every part of the world.

Government:—The government must be of such a character as to ensure the absolute disinterestedness of the management. A suspicion that the organization is to be used for private gain will destroy its usefulness. To ensure this the title should vest in the Regents of the University. But the immediate supervision should be in the hands of a smaller body; the composition of which is a matter for careful consideration.

Management:—A manager appointed by the governing body should appoint and control all assistants. The University departments should be utilized so far as possible, especially for the work of examining and analyzing the exhibits.

Membership:—The Philadelphia Commercial Museum seems to afford a model for the regulation of membership. Any manufacturer or merchant in the United States may become a member on the payment of an annual fee. While the endeavor should be made to make the museum eventually self-supporting, yet all the funds obtainable should be spent in the work. Members must be assured that no profit is made from their fees, which should not be larger than is necessary for the collection of the information. All members should receive in like degree, freely, any and all of the information that can be obtained. An extra charge proportionate to the expense incurred should be made for special reports of an unusual character.

Affiliations:—For mutual advantage the museum should be affiliated with the Philadelphia Commercial Museum and with any similar organization that may be established elsewhere. The terms of such affiliation should ensure the complete interchange of information and exhibits and a division of the field of work in such a way as to avoid so far as possible any duplication of expenses. The

Philadelphia Commercial Museum has already expressed a willingness to affiliate in such a way with a museum established here, and the exact terms of such affiliation can be easily arranged by negotiation.

Expenses:—With the information now on hand it is not possible to make an exact estimate of the expenses. Enough is known, however, to warrant the statement that less than $25,000 per annum would be insufficient and that for every increase above that sum the advantages afforded would increase in more than like proportion. A more exact determination of the indispensable annual income can be obtained by consultation with the management of the Philadelphia Museum. Besides an assured annual income, the museum will require a large building centrally located and well-lighted.

Sources of Income:—In view of the present weakness of manufacturing industries on the Pacific Coast it will probably be some years before the museum can be self-supporting. Some other source must be appealed to for the expenses of establishment and for support during the first five years.

First Steps:—The preliminary work necessary for the formation of a successful working plan will require time and money. As soon as the necessary financial support is assured, an agent should be sent from here to the Philadelphia Museum to study the form of their organization, and to prepare a plan. After the plan has been adopted and a suitable building obtained, it would seem desirable to obtain the assistance of some competent member of the staff of the Philadelphia Museum for the arrangement of the details of organization and work.

ON THE METHOD OF ENGLISH STUDY IN SECONDARY SCHOOLS.*

By CORNELIUS BEACH BRADLEY.

Mr. President and Fellow-Teachers: My topic as announced is The Method of English Study in Secondary Schools; but at the very start I wish to put myself right in this matter, by stating my firm conviction that no such thing as *the* method of English exists; that there is no such definite, concrete, communicable entity anywhere to be found. Of methods there are many, more or less successful in the hands of those who have developed them; but none that can be safely prescribed and copied. *The* method of English is an ideal, like that other ideal of the perfect prose style, suitable for all authors and all purposes. But style is the perfect adjustment of expression to the particular thought, mood, and personality of a certain author, and as such cannot be copied. There are therefore many literary styles, each admirable in its own place, and in the hands of the one whose expression it is; and there are many methods of teaching which may be admirable in the hands of those who have made them their own.

Ideals of this sort are, in fact, adjustments rather than plans or schemes. Every method of teaching involves, at least, a four-fold adjustment between teacher, pupil, material of study, and the end in view. If we may consider the last term as fixed, we have still what the mathematicians

* An address at the San Francisco Teachers' Institute, April 12, 1899.

would call an equation of three variables. Taking up these three variables separately, we shall find that teachers—good and competent teachers—vary so much in tastes, sympathies, habits of thought, and in all the features of personality, that we cannot lay down any clear law for the adjustment on their side; things which are easy for one are utterly impossible for another. The same thing is true of classes and of individual pupils. And when we come to the material of English study, we find that every separate piece of literature calls for a different treatment. Adjustment of method on these lines, therefore, is quite beyond the scope of profitable discussion here. It must in any event be left very largely to be worked out as the tact and the genius of competent teachers shall in each case determine.

But turning now to the fourth item, the end in view, we find that it gives us the key to all these other adjustments. What are the ends of English instruction? They are three: knowledge, inspiration, utterance. It may be said that these are the general ends of all education; and in a sense this is true. But the special opportunities and needs of English instruction serve greatly to limit and differentiate these general ends. Thus knowledge—information, acquisition of the data of thought—is fundamental and common to all departments of instruction. But the particular kind of data furnished by the study of literature is unique. The mathematics acquaint us with certain primary conceptions of space and magnitude. Physical science informs us concerning matter and force. Languages give us the elements and the laws of expression in words. But literature reveals to us facts of an entirely different order—knowledge of spiritual states and activities, of the play of the human heart and imagination; and this calls for a method and treatment of its own, entirely distinct from that of the others.

If, as we have seen, in the item of knowledge the discipline of the English course is thus sharply distinguished from other disciplines, still more is it distinguished in the

item of inspiration, sympathy, the awakening of the spiritual and emotional nature. Within the school literature has this field almost wholly to itself; except in so far as history with its noble characters and enthusiasms may touch it upon one side, and music with its lyric rapture may touch it upon the other. How to deal with this central, vital element of the English discipline, and still not debase and weaken it into sentimentalism, gush, or hypocritical pretense of feeling; and, on the other hand, not kill it altogether with the hard edge of a rigid formalism—is perhaps the most difficult problem of this whole subject. The teacher himself needs here to be very surely and justly balanced. And the two sexes, doubtless, need different treatment, so as not to overemphasize the natural tendency of each, but to make sure in each case that the complementary discipline and insight is not missed;—that the girls get the firm grasp of knowledge and clear thinking needful to support their quicker sympathies and enthusiasms; and that the boys fail not, through hardness or formalism, of the softening and civilizing influence of true feeling.

And, lastly, the discipline of utterance must keep pace with the growing knowledge and the awakening feeling which the other two disciplines afford. It must do this, not because utterance is an easy and convenient test of acquisition, nor even because through it alone the pupil can become truly and completely human—an articulate-speaking creature,—but quite as much for its reaction upon the man himself, that utterance may quicken and clarify both thought and feeling. On this point much has been said in recent discussion, and needs not to be repeated here.

These then, it seems to me, are the guiding stars of method in the teaching of English. And permit me to remark in passing that I distinguish between the discipline of *studying* literature, and that other discipline of *reading*, whether undertaken at one's own instance, or as an auxiliary and supplement to study proper. To the latter discipline, of course, much more vagueness and laxity is properly

permitted. And for this reason it has never seemed to me wise to confound the two disciplines by including them together in a required course of study. A safer plan would be to include in the requirement those works only which are to be *studied*, and to leave the *reading* to be suggested by those who are in a position to judge more accurately of the possibilities and the needs of individual cases.

I began, you will remember, by saying that *the* method of English does not exist. But a method which so deals with literature as to secure, first of all, a knowledge of its masterpieces that shall be clear-cut, vivid, vital, avoiding the whirlpool of vague impressionism on the one hand, and the deadly rock of hard, mechanical formalism on the other; a method which secures to the young spirit an inward quickening of imagination and feeling that shall be real and genuine; which secures to knowledge and to feeling such expression as shall stimulate and clarify;—a discipline in which knowledge gives the firm basis for feeling and utterance, while feeling warms and humanizes knowledge and expression, and expression reacts upon both the others—such a discipline, I think may well be called the method of English instruction.

MACADAM ROADS AND ROAD METALS.

Authorities are agreed upon the following points relating to the stone to be used in making macadam roads:

The macadam stone when ready for use should be in small, sharp, angular fragments, as nearly uniform in size as practicable. No stones larger than prescribed, nor any with rounded surfaces should be introduced into the mass, as such would prevent thorough consolidation.

Sizes of stone all the way from one and one-half inches in greatest dimension to two and one-half inches are advocated by different road engineers. The smaller sizes are more readily consolidated by rolling in making the road, and are sooner brought to a smooth surface.

If the stone thus called for be carefully laid and rolled it will be compacted into a solid mass, having an even, hard, and inelastic surface.

The quality, also, of the stone should be uniform; as otherwise the road covered with it will soon become unequally worn at different points, and depressions will appear in those places where the stone is softest.

To be durable on the surface of a road it should be very hard and tough: hard in order that it shall resist very strongly any distortion of shape; tough, that it shall resist heavy blows without suffering fracture; and it should be, while slightly elastic, exceedingly cohesive.

The qualities of toughness and resistance to abrasion are more important to road metal than hardness and resistance to crushing. A stone may be hard, and yet be brittle

and easily pounded into dust; or, it may resist crushing to a remarkable degree, while at the same time it may wear away quickly by abrasion from the grinding action of wheels.

If the stone be too soft, it will soon be crushed under the heavy loads coming upon it, be converted into dust, and prove defective as to durability. The use of such macadam material speedily results in a very muddy or dusty, disagreeable road.

The stone should also "weather" well; that is, resist satisfactorily the disintergrating influences of the atmosphere and of gases contained therein.

The less water the stone is capable of absorbing the better, as the destructive action of frost will correspond to the quantity of water absorbed.

The best authorities are also of the opinion that thorough tests of the toughness, resistance to abrasion, and absorption of water should always be made before selecting the particular quarry to be brought into use. Some road builders require, also, tests of the crushing resistance; but such tests are not often made.

The most desirable kinds of stone are those which may be broken only with much difficulty. The basalts and tough trap rocks, particular the older ones geologically, which contain much horneblende, are usually excellent. Sienitic granites, involving much horneblende, in place of felspar, when dense and dark colored, are often good.

Hard, tough, crystalline limestones are frequently suitable.

Greenstone is variable in quality, running down from excellent in some cases to very poor in others. In many instances it is too easily broken and crumbled.

Flints, quartz, and silicious stones generally, although hard and unaffected by the atmosphere, frost, etc., are not tough enough, and frequently are very brittle.

The ordinary granites, slates, limestones, and sandstones usually are inferior materials, being too soft; so that

while affording a smooth road surface soon after being laid, they are quickly rendered slippery in wet weather and dusty in dry seasons. Moreover, they wear away rapidly under the action of heavy loads.

The Need of the Tests.—As the rock used for macadam varies a great deal in characteristics; some kinds of rock being soft and others hard, some brittle and others tough, some absorbing a large percentage of water, and others absorbing little or none, it is necessary to have tests to determine these characteristics, and to ascertain how they affect the use of the rock as macadam. A good test should conform as nearly as possible to the conditions under which the rock is to be used. The best test would be to lay a stretch of road with a given kind of macadam, subject it to the traffic which it would be actually required to stand, and thus learn how it would endure traffic; but in most cases this is impracticable.

Probably the best feasible (or practicable) test that can be successfully applied to determine the quality of rock for macadam is the "Rattler Test." In this test the abrasion of the rocks on each other is supposed to take the place of the abrasive action of the hoofs of the horses and of the wheels of the wagons. As can be readily seen, this idea holds true to a limited extent only; but the test seems to answer very well for rock that is to be used on streets and roads where the traffic is comparatively heavy, and where a hard, tough rock is required. It is too severe to apply to rock that is to be used where the traffic is light, as on most country roads. There, rock which is not so hard and tough, but which possesses good cementing qualities, may make a good smooth surface, and wear well under the light traffic to which it is subjected.

The "Absorption Test" is used to determine the liability to injury of the road from freezing and thawing. The more water the rock absorbs, the more liable the road is to be injured.

The "Specific Gravity Test," although giving no direct indication of the wearing qualities of the rock, is useful in showing its density. Generally, the densest rocks are the best.

The Rattler Test.—The rattler with which the tests are made is shown in Plate 1. It is an iron box, hexagonal in cross-section, as shown by the plan of the ends, Fig. 1, Plate 2. The plan of the sides is shown in Fig. 2, Plate 2.

Plate 2.

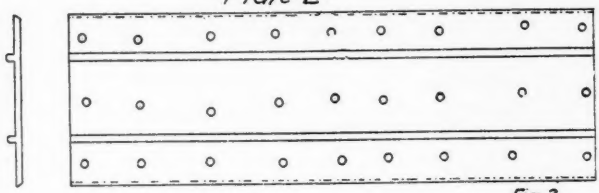


Fig. 2.

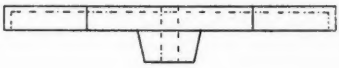
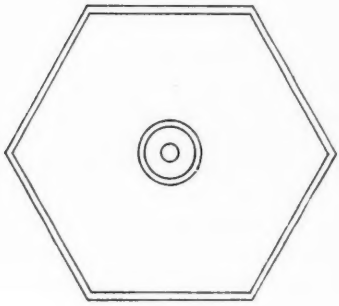


Fig. 1.



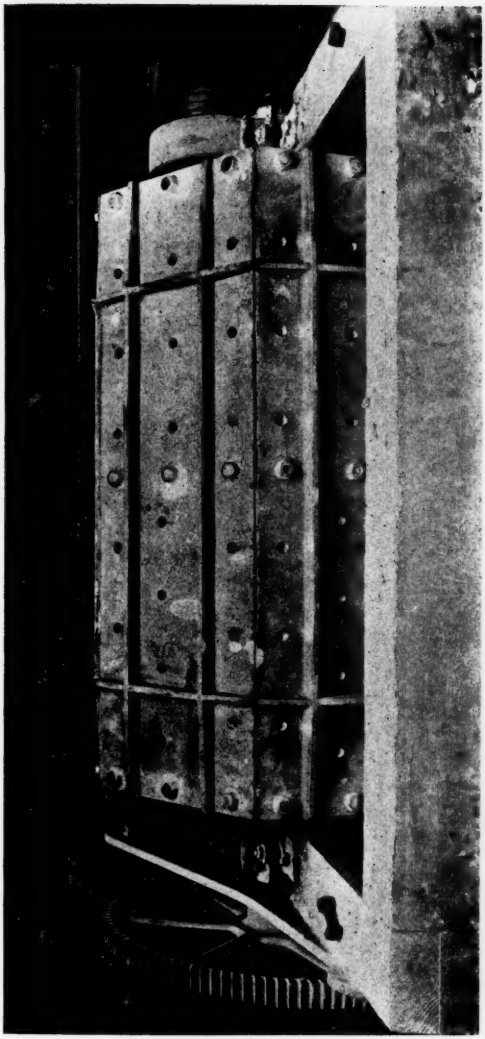
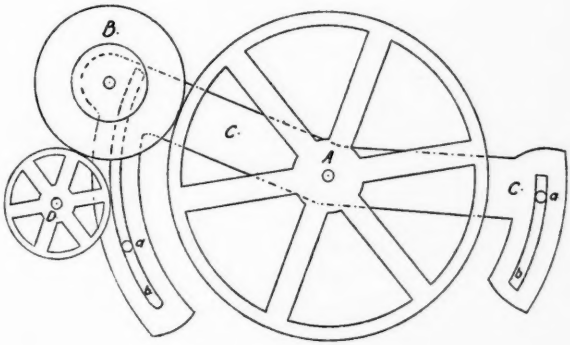


Plate 1.

The rattler is divided by an iron partition into two equal compartments. One of the plates was unbolted and taken off when rock was to be put in or taken out. The inside measurement of each compartment gives fourteen inches by twenty inches; or a capacity of 5.87 cubic feet.

Plate 3.



The speed of the rattler was regulated by a system of cogwheels, shown in Plate 3. *A* is a cogwheel keyed to the same shaft as the rattler. It is turned by the idler *B* which rotates on a shaft passing through the "spider" *C*. The "spider" is fastened to the frame by means of the bolts *(aa)*. When the bolts are loosened the "spider" may be turned on the rattler shaft as an axis, as the bolts run through the slots *(bb)*. This moving of the "spider" moves the idler *B* up and down. *B* is turned by the cogwheel *D* which is keyed to the driving-pulley shaft. Four different cogwheels may be used at *D*, and the idler *B* is a double cogwheel, and can be placed at two different points on the

"spider;" so that, theoretically, sixteen different speeds may be obtained; but actually, owing to duplication of speeds and to some combinations which cannot be used, only about eight different speeds are possible. The revolutions of the rattler were numbered by a mechanical revolution counter attached to the rattler shaft.

Before making the tests a preliminary test was made to see what effect different weights of rock placed in the rattler would have on the per cent. lost. Rock of the same kind was placed in the two compartments, 100 pounds in one, and 125 pounds in the other. In this way both weights were subjected to the same speeds, and other conditions.

	N. Comp. Pounds.	S. Comp. Pounds.
Original weight of rock	100.00	125.00
Weight at the end of 500 revolutions	93.75	117.00
Weight at the end of 3000 revolutions	82.50	102.75
Weight at the end of 5000 revolutions	76.50	96.25
Per cent. lost in 500 revolutions	6.25	6.40
Per cent. lost in 3000 revolutions	17.50	17.80
Per cent. lost in 5000 revolutions	23.50	23.00
Per cent. lost in last 4500 revolutions	18.40	17.70

This test shows that the difference in the weights of the samples made little difference in the percentage lost. The small difference in percentage is probably due in great part to slight differences in the quality of the rock used.

In making the tests a speed of twenty-eight revolutions per minute was maintained as nearly as could be. It varied somewhat owing to the difference of weight of rock in the rattler, etc. 125 pounds of rock was used for the tests whenever we had that amount on hand, and of the other samples we used what we had. The tests were made as follows: The rock was weighed to the nearest one-quarter pound, was then placed in the rattler, and turned through 500 revolutions. The rock was then taken out and weighed again and put back in the rattler, and turned through 4500

revolutions more, making 5000 revolutions in all. The rock was then taken out and weighed for a third time.

Absorption and Specific Gravity Tests.—In making these tests, samples taken at random and weighing 1000 grams or more were used. The same samples were used for both tests. Since the least reading of the scales used was one-tenth of a gram, the results are correct to one one-hundreth of one per cent.

The absorption, as a per cent. of the dry weight, is the difference in weight of the specimen after the absorption of water, and its weight when divided by the dry weight. The specific gravity is the weight ~~wet~~ dry divided by the difference of the ~~dry~~ wet weight and the weight in water.

From the above it is seen that the dry weight, wet weight, and weight in water are required in these tests. They were found as follows: The samples were weighed, numbered for identification, and placed in an oven to dry. This first weighing was not used in the calculations, but served as a check on the wet and dry weights. The samples were subjected in the oven to a temperature of 110 to 130 degrees Cent. for at least ten hours; which was sufficient to drive off all moisture. After weighing (this being the dry weight) they were immersed in water for four weeks. In that time practically the full percentage of water capable of being absorbed is taken up. The specimen was then weighed in water by placing it in a can which was immersed in water, suspended by a fine wire from the scale. The specimen was then removed from the water, the water on the surface wiped off, and the specimen weighed, this being the wet weight.

All samples of rock used in the latter tests were passed through a 2½-inch ring, and were retained on a 1½-inch ring.

TABLE SHOWING KIND, CONDITION, ETC., OF ROCKS TESTED.

NOTE.—The numbers used for rock in this table will be used in the succeeding tables.

1.—California Improvement Company, 1003½ Broadway, Oakland. Quarry, Laundry Farm, Alameda County. This rock is probably a volcanic breccia, altered by dynamic action. It had sharp angular corners and was already crushed to the required size when received.

2.—F. A. Steiger, Vacaville, Solano County. Quarry, Vacaville. This rock is a dark basalt having a small amount of cementing material in the joints and cleavages. It was sharp and angular and broken to the proper size when received.

3.—E. R. Thomason, 328 Montgomery Street, San Francisco. Quarry, Cordelia, Solano County. The rock is a fine grained blue basalt. It was broken by hand at the quarry into two or three inch cubes and broken by hand again to the required size at the University.

4.—Petaluma Paving Company, Petaluma, Sonoma County. Quarry, Petaluma. This was a sharp angular basalt rock, which was broken to required size when received.

5.—State Quarry, Folsom, Sacramento County. This rock was received through the kindness of C. L. Knight, U.C. '93. It is an amphobolite consisting mostly of horneblende with a small amount of feldspar, and was received in large pieces that were broken up by hand at the Civil Engineering Laboratory.

6.—J. T. Cochran & Co., Oakland. Quarry, Iron Rock Quarry, north of Berkeley. This is a metamorphic siliceous rock with secondary calcite, perhaps an eruptive. The rock was sharp and angular, and was broken to required size when received.

7.—Oakland Paving Company, Central Bank Building, Oakland. Quarry, McAdam Street, near Broadway, Oakland. This rock is probably a metamorphic sandstone, with secondary veins of quartz and calcite, but possibly it is an eruptive rock. The rock was sharp and angular and of the required size when received.

8.—Piedmont Paving Company, Oakland. Quarry, near Piedmont. This rock is an altered sandstone, mainly quartz. The rock received was of the required size and the corners were sharp.

9.—City of Santa Rosa. Quarry, Santa Rosa, Sonoma County. We are indebted for this sample of rock to Mr. N. V. V. Smith, City Engineer of Santa Rosa. It is a trap rock with sharp angular corners and was of proper size when received.

10.—Gray Brothers, 316 Montgomery Street, San Francisco. Quarry, Twenty-sixth Street, San Francisco. This rock is a grayish altered sandstone containing veins of calcite, with corners more or less rounded. It was of the proper size when received.

11.—Gray Brothers, 316 Montgomery Street, San Francisco. Quarry, Sansome Street, Telegraph Hill. This rock is a bluish sandstone and contains veins of calcite, with corners a good deal rounded.

12.—City of Eureka. Quarry, Eureka, Humboldt County. This rock was received through the kindness of W. C. Elsenore, City Engineer. This rock is a basic eruptive or trap, with sharp angular corners; and was mostly of the required size when received.

13.—P. F. Maloney, Superintendent of Streets, San Mateo. Quarry, Byrnes' Stone Quarry. This rock is a metamorphic limestone, with sharp angular corners; and was of the required size when received.

14.—Benicia Rock Crushing Company, Benicia, Solano County. Quarry, near Benicia. This rock is an old, altered, eruptive rock, or trap. It was an average sample from three or four strata, and was received in large pieces which were broken to the required size at the Civil Engineering Laboratory.

15.—I. L. Thurber, 465 Pacific Avenue, Santa Cruz. Quarry, near Santa Cruz. This rock, an old crystalline limestone, was received mostly in large pieces and was broken by hand in the Civil Engineering Laboratory. Owing to its character, this rock has rather blunt corners.

16.—W. E. Miller, Santa Cruz. Quarry, near Santa Cruz. This rock is also an old crystalline limestone, but with fairly sharp corners, and was broken to the required size when received.

17.—J. A. Buchanan, Superintendent of Streets, Pasadena. Quarry, near Pasadena. This rock is a diorite, and was received in large pieces that were broken to the required size by hand in the Civil Engineering Laboratory.

18.—P. F. Maloney, Superintendent of Streets, San Mateo. Quarry, Casey's Quarry, near San Mateo. This sample is an altered silicious rock mainly quartz, with sharp angular corners, and was of the required size when received.

19.—A. P. Johnson, Belmont, San Mateo County. Quarry, near Belmont. This rock, which is "chert," was received mostly in large pieces and was broken by hand in the Civil Engineering Laboratory.

20.—Golden Gate Park Quarry, San Francisco. We are indebted for this rock to the Golden Gate Park Commission and to J. McLaren, Superintendent of Golden Gate Park. This rock is also a "chert," and was received in large pieces that were broken by hand in the Civil Engineering Laboratory.

21.—Cushing, Wetmore & Co., 508 California Street, San Francisco. Quarry, Telegraph Hill, San Francisco. This rock is an altered sandstone with veins of calcite. As the sample received was too small for such use, no rattler test was made on this rock.

NOTE.—We are indebted to Dr. Louderback and Mr. Anderson of the Mineralogical Department of the University of California for the classification of the different samples of rock.

TABLE NO. 1. RATTLER TESTS.

No.	Weight of Rock Used.	Weight at 500 Rev.	Weight at 5000 Rev.	Per Cent. Lost in 500 Rev.	Per Cent. Lost in 5000 Rev.	Per Cent. Lost in Last 4500 Rev.	Aver. Speed.
1	125	121.00	111.50	3.2	10.8	7.9	28.0
2	125	119.25	109.25	4.6	12.6	8.4	28.6
3	125	119.75	109.50	4.2	12.4	8.6	28.0
4	125	120.00	106.75	4.0	14.6	11.0	28.8
5	125	119.00	104.75	4.8	16.2	12.0	28.3
6	125	119.00	103.25	4.8	17.4	13.2	28.6
7	100	96.50	83.50	3.5	16.5	13.5	28.5
8	125	119.25	101.50	4.6	18.8	14.9	28.3
9	125	119.25	100.50	4.6	19.6	15.7	29.0
10	125	119.50	97.75	4.4	21.8	18.2	28.7
11	125	119.00	96.50	4.8	22.8	18.9	28.7
12	123	113.50	89.00	7.7	27.6	21.6	28.5
13	125	116.75	87.50	6.6	30.0	25.1	28.7
14	125	112.00	82.25	10.4	34.2	26.6	28.8
15	125	109.25	71.25*	12.6	43.0†	34.8‡	29.3
16	115	100.75	62.25	12.4	45.9	38.2	29.0
17	110	73.50	43.00	33.2	60.9	41.5	29.0
18	110	64.00	13.75	41.8	87.5	78.5	28.7
19	125	56.75	9.25*	54.6	92.6†	83.7‡	29.3
20	75	30.25	4.00	59.7	94.7	86.8	29.0

* Weight at 4500 revolutions.

† Per cent. lost in 4500 revolutions.

‡ Per cent. lost in last 4000 revolutions.

TABLE No. 2. ABSORPTION TESTS.

No.	Weight before Drying.	Weight after Drying.	Weight after Soaking.	Wet Weight Less Dry Weight.	Per Cent. of Water Absorbed.
1	2038.7	2034.0	2040.1	6.1	.30
2	1015.0	1011.4	1015.6	4.2	.42
3	2128.6	2115.1	2129.0	13.9	.66
4	1035.7	1031.6	1036.7	5.1	.49
5	1688.2	1687.2	1687.9	1.0	.06
6	1314.8	1312.9	1315.2	2.3	.18
7	1000.4	998.5	1001.8	3.3	.33
8	1383.5	1380.4	1385.8	5.4	.39
9	1090.9	1083.2	1105.7	22.5	2.08
10	2330.0	2320.1	2333.7	13.6	.59
11	2131.9	2117.8	2135.8	18.0	.85
12	1017.3	1011.4	1025.4	14.0	1.38
13	1183.2	1182.2	1185.1	2.9	.25
14	1953.2	1912.7	1973.0	60.3	3.15
15	1421.3	1419.7	1424.5	4.8	.34
16	1117.4	1115.5	1118.9	3.4	.30
17	1236.8	1233.2	1240.9	7.7	.62
18	1149.8	1145.4	1156.0	10.6	.93
19	1237.9	1233.0	1248.3	15.3	1.24
20	.....	1867.1	1909.8	42.7	2.29
21	1076.5	1070.3	1079.5	9.2	.86

TABLE No. 3. SPECIFIC GRAVITY TESTS.

No.	Weight Dry.	Weight in Water.	Weight Wet	Weight Wet Less Weight in Water.	Specific Gravity. (Dry.)
1	2034.0	1268.0	2040.1	772.1	2.63
2	1011.4	655.5	1015.6	360.1	2.81
3	2115.1	1365.3	2129.0	763.7	2.77
4	1031.6	678.3	1036.7	358.4	2.88
5	1687.2	1122.6	1687.9	565.3	2.98
6	1312.9	894.1	1315.2	421.1	3.12
7	998.5	631.4	1001.8	370.4	2.70
8	1380.4	871.9	1385.8	513.9	2.69
9	1083.2	700.0	1105.7	405.7	2.67
10	2320.1	1471.1	2333.7	862.6	2.69
11	2117.8	1336.0	2135.8	799.8	2.65
12	1011.4	679.9	1025.4	345.5	2.93
13	1182.2	740.6	1185.1	444.5	2.66
14	1912.7	1159.2	1973.0	813.8	2.35
15	1419.7	897.3	1424.5	527.2	2.69
16	1115.5	705.2	1118.9	413.7	2.70
17	1233.2	789.2	1240.9	451.7	2.73
18	1145.4	709.0	1156.0	447.0	2.56
19	1233.0	764.1	1248.3	484.2	2.55
20	1867.1	1172.7	1909.8	737.1	2.53
21	1070.3	675.7	1079.5	403.8	2.65

Results of Tests.—In 5,000 revolutions of the rattler, four rocks lost less than fifteen per cent., nine rocks lost less than twenty per cent., and eleven rocks lost less than twenty-five per cent. Under the most stringent specifications demanded in San Francisco and vicinity, the first four are Class A rock, and the next five are Class B rock. The first eleven would be acceptable in San Francisco under their specifications. We think these tests show that the last nine rocks will be suitable for light traffic only. The density of the rock seems to have no connection with the results of the rattler test.

We are greatly indebted to the Southern Pacific Company, which, upon the initiative of Wm. Sproule, Esq., General Freight Agent, and W. G. Curtis, Esq., General Superintendent of the Maintenance of Way, furnished free transportation over its lines for most of the rock tested.

The tests were made by F. E. Frey and C. H. Towle, under the immediate supervision of Assistant Professor H. I. Randall and Instructor L. E. Hunt.

I desire to call the attention of macadam paving companies and owners of stone quarries in this State to the fact that upon the receipt from any of them of samples, expenses prepaid, we will return, free of charge, a certified report of the results of the tests upon the macadam stone. The samples should be strongly and carefully sacked, and addressed as indicated above, and should weigh at least 200 pounds.

FRANK SOULÉ,
Professor of Civil Engineering.